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Regional workshop on the Role of Coal
in Accelerated African Economic Growth

Addis Ababa, Ethiopia, 11-15 July 1983

ENVIRONMENTAL ASPECTS OF THE PRODUCTION AND UTILIZATION OF COAL IN AFRICA

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I. INTRODUCTION

1. To enhance the pursuance of its economic and social objectives for the development of the region, ECA has developed a series of strategies to assist member States in the exploitation of their mineral resources in such a manner that will ensure environmentally sound development. 1/

2. With the present oil glut and the consequent fall in the unit price of petroleum, it would appear that the energy crises of the late 1970s and early 1980s is over. This might be true, but it would only be the case in the more developed economies where the available financial and technological resources have made it possible for the development of alternative sources of energy. In the developing economies of the Third World, within which Africa finds herself, the crises are still there because, the resources, financial, technological and manpower have not yet been developed to cope with the situation, and develop an awareness of the environmental problems that come with the search for alternative sources of energy.

3. Over 80% of the population of Africa lives in rural areas and relies on fuelwood as the only source of energy for domestic use as well as in artisanal industries like smithing and iron-mongery. This high reliance on fuelwood as a source of energy is creating far reaching environmental problems such as deforestation, consequent soil degradation and desertification. Although research is being carried out into methods of harnessing available renewable sources of energy, the exploitation of the African coal resources would greatly alleviate the present energy problems and will help towards providing solution to some of the environmental problems arising from fuelwood exploitation.

1/ E/CN.14/NR/80/9: Environmental aspects of the development of mining and mineral processing industries in Africa.

* For technical reasons this paper was not edited.

4. The purpose of this paper is to emphasize the environmental concern of mineral exploitation and use within the context of coal production as relates to its contribution to development in the region. The objective here is to highlight the environmental implications of coal production and utilization so as to develop an awareness of the environmental problems that should be anticipated and possible measures that could be taken to alleviate them if total solutions cannot be found for them.

5. Consequently, this paper reviews the issues of coal production and the environment (Part II); coal utilization and the environment (Part III); coal production and utilization and the African environment (Part IV); and the necessary precautions and recommendations that should be taken for environmental protection (Part V).

II. COAL PRODUCTION AND THE ENVIRONMENT

6. Three types of coal, all appearing close to the surface rock, namely: lignite, sub-bituminous coal and bituminous coal. The other type anthracite is found deeper into the earth's crust and has a different methods of exploitation which do not have the same environmental impact as the other three.

7. Lignite, the upper formation of these carboniferous rocks is deep brown or black in colour and has a high moisture content of 30 - 70% and is very liable to spontaneous combustion. Although it has a low heat producing capability, it produces high volumes of black smoke and particulate material into the atmosphere. Sub-bituminous coal has lesser moisture content, 15 - 03, than lignite, but more than bituminous coal which is less fragile and can be used as coking coal. The methods of production for these three types of coal result in very profound changes in overall configuration of the local environment - the physical as well as the human. 2/

8. Since these coals are very close to the land surface and in some case do out-crop, the method used for mining is open-cast which results in the scarification of the landscape. Scarification results from strip or surface mining which might differ from place to place depending on the configuration of the land where the coal deposit is found. Consequently, open-pit coal mining is used to remove thick veins of coal appearing at the surface, or area strip mining in areas where the terrain is relatively flat, or contour strip mining in areas of high rolling or mountainous relief of auger mining for removing coal seams that are exposed on a hillside for example.

2/ A.N. Strahler and A.H. Strahler (1977): Geography and Man's Environment (John Wiley and Sons, New York), Part VIII.

9. The environmental impacts of strip mining include the loss and/or degradation of surface vegetation and depletion in the wildlife that depend on it. Even where rehabilitation of the land is attempted the problem still remains that the spoilt ridges left by strip mining are very prone to rapid erosion. The eroded material, if in large quantities can cause the aggradation of stream channels if carried down valley. On mountain slopes there might be mass-wasting in the form of mud earth or mud flows that can affect unstable spoil banks. Where there are sulphur bearing minerals in the coal seams, acid water drainage might result severely affecting the streams of the area.

10. In arid and semi-arid areas the environmental impacts are more sever than in the humid areas. Arid and semi-arid land shrubs, woodlands and grasslands do not regenerate rapidly if destroyed nor can they recover unless they are very carefully regenerated. The mining spoils cannot store water for plant use and in many cases salts and toxic minerals, unfavourable to the local plants are exposed. Coal seams might lie between aquifers in artesian groundwater systems and strip mining can physically disrupt the aquifer and the quality can be impair by the release of contaminants from the broken rock. Pumping out water from a mine can also lower the water-table of the surrounding region and cause wells used for agriculture to dry up.

11. Sub-surface mining, particularly for anthracite, and auger mining can result in land subsidence because the mining activity destabilizes the tectonics of local environment.

III. COAL UTILIZATION AND ENVIRONMENTAL PROTECTION

12. Coal is most likely to be processed for two by-products, namely: synthesis gases and solid smokeless fuels.

13. Synthesis gases that have a coal base include ammonia or nitrogen trihydride, methanol or methy alcohol which is a liquid hydrocarbon, and gasoline. All of these gases require careful handling to avoid large amounts being released into the atmosphere thereby rendering it hazardous. Coal with sulphur minerals can be environmentally hazardous if large quantities of sulphur based gases (H_2S, SO_2) are released because of the risk of sulphur compound forming in the air and resulting in "acid rain", high solution of sulphuric acid, precipitation which has been shown to be destructive to plants and dwellings.

14. Coal is also processed for solid smokeless fuels by low temperature carbonization process for coke and oils suitable for gasoline and diesel oil. The environmental hazards here arise from the effluents which include crude tar, crude ammonia, and unpurified gases.

IV. COAL PRODUCTION AND UTILIZATION AND THE AFRICAN ENVIRONMENT

15. A conservative estimate gives Africa's coal reserves at about 86,560 million metric tons of which 72,465 million are in the Republic of South Africa and 14,095 million in the rest of Africa. Most of it is lignite, sub-bituminous or bituminous coal distributed mainly as follows, in millions of metric tons:

1. Algeria (anthracite and bituminous), 20, mainly in Kechar region;
2. Egypt (bituminous), 51, in the Suez Canal area;
3. Botswana (bituminous), 500;
4. Lesotho (lignite and bituminous) figures not available;
5. Madagascar (lignite and bituminous), 92, Antsile area, north of Tulear;
6. Malawi (bituminous), 14;
7. Morocco (anthracite and bituminous), 190, in Atlas region;
8. Mozambique (bituminous), 700, in the region of Tete;
9. Nigeria (lignite and bituminous), 423, in the Anambra state area;
10. Sierra Leone (lignite), figures not available;
11. Swaziland (anthracite and bituminous), 5,022;
12. Tanzania (bituminous), 370;
13. Zaire (bituminous), 75;
14. Zambia (bituminous), 115;
15. Zimbabwe (bituminous), 5,813.

16. Apart from these reserves, there are those which are scattered all over the continent which have not yet been explored.

17. As can be seen from the above list, Africa's coal reserves are of the type of coal, lignite and bituminous, whose exploitation will result in profound changes in the configuration of the land surface. Furthermore, it is also the type of coal whose use has a high water, land and air pollution potential.

18. Strip mining results in scarification which involves the removal of the top soil to uncover the coal seams. The environmental problems arising from the strip mining of coal are particularly those that render the sub-soil extremely fragile and expensive to rehabilitate. As earlier indicated, this problem is even worse when the mining site is in a semi-arid region because of the natural problem of regenerating the scanty vegetation in fragile ecosystem. As would be seen from the list of African countries with considerable coal reserves, all of them are either in desert zones or are liable to desertification.

19. In countries like Algeria, Morocco and Egypt, the reserves are in the desert, in the eastern slopes of the southern Atlas Mountain for Algeria and Morocco and in the Suez Canal area for Egypt. The environmental problems begin with settling the mine workers and providing public utilities and other facilities for them. The next problem is the rehabilitation and management of the spoil ridges bearing in mind the fact that semi-arid land ecology is very difficult to rehabilitate once tempered with.

20. In the more humid countries of the tropics, excavation of the surface soils in the course of strip mining encourages the process of soil degradation and eventual desertification through deforestation or removal of existing vegetation. Heavy rains do provide mass-wasting, particularly on hill slopes, in the form of mud flows and landslides.

21. Although, as of now, the use of coal for domestic purposes is almost negligible in Africa, it is useful to be aware of the environmental impacts of the combustion of coal. These include, of course, air pollution with particulate carbon material, oxides of sulphur with an increase in the carbonic material content of the local atmosphere. These could cause hazards to the physical environment and adversely affect human health if present in large quantities.

V. NECESSARY PRECAUTIONS FOR ENVIRONMENTAL PROTECTION IN COAL PRODUCTION IN AFRICA

22. It is important to take precautionary measures to develop a legal and institutional framework to protect the environment, particularly before natural resources are exploited. Where exploitation had begun before any measures were thought of, it will be necessary to amend existing regulations to assure remedial measures that would achieve this at (a) national level and (b) multi-national level. These measures should include the environmental impact assessment (EIA) of coal production and use in rural and urban areas.

(a) At national level

23. It will be necessary to develop institutional and legislative structures that would ensure:

(i) Progressive rehabilitation of spoil ridges in mined-out areas to avoid mass-wastage and restore soil quality, particularly in arid and semi-arid areas;

(ii) That where sulphur occurs in the coal seams, necessary measures are taken to cope with the effects of sulphur-base toxic materials;

(iii) That care is taken to maintain water quality, especially as pertaining to ground water resources where exploitation may traverse an aquifer which might then be liable to contamination;

(iv) That human settlement and building construction planning in areas where coal is most likely to be used be done incorporating measures to cope with solid and non-solid coal wastes and effluents from combustion; and

(v) That the siting of industry and thermal plants which will use coal as a source of energy be done in a manner to preserve the quality of water, air and the local ecology.

(b) At the multinational level

24. Many coal reserves lie across country boundries or in such a way that its exploitation and use might have environmental impacts beyond the country that has the reserves. In such a case the necessary instruments of co-operation should be established by the countries concerned to cope with the problems of exploiting shared coal reserves. Such instruments might include multinational groups of environmental experts to monitor the cross-boundary impacts of exploitation and utilization and joint rehabilitation programmes for mined-out sites.